

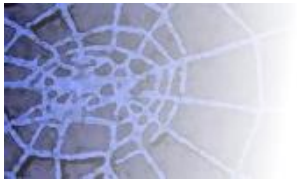
Internet of Things (IoT) and the network economics of operator platforms

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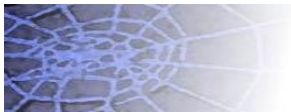
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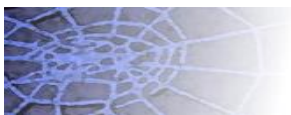
Online platforms versus operator platforms

- Online Platforms and online intermediation services encompass online e-commerce market places, online software application stores as well as online social media. EU rules on competition, consumer protection, transparency obligations etc. have been strongly focused on online platform-based services for content industries. Online intermediation services organized via online trading platforms play an intermediary function for online exchange of goods, services or information between sellers and consumers typically without changing the items or information exchanged.
- In contrast, operator platforms play an active role in the creation of new innovative markets of smart network infrastructures and physical network services. The complementary role of operator platforms organizing the production of physical network services evolving in the Internet of Things (IoT) is analyzed.
- The focus of this paper is on the governance of operator platforms driven by the requirements of IoT applications and the future role of entrepreneurial decision making within operator platforms.



From conventional network industries to operator platforms

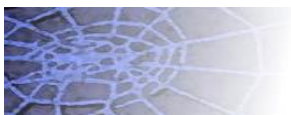
- The basic innovation of IoT is the pervasive interaction of the physical networks with complementary virtual networks enabling real-time, location-specific, adaptive capacity allocation decisions.
- The evolution of the IoT would not been possible without the rapid innovations in communication networks. Of particular relevance are innovations within all-IP broadband networks providing stochastic as well as deterministic quality of service (QoS) guarantees.
- Different virtual network providers combine the required broadband capacities within the geographical area of its virtual network with other dimensions of the virtual network required such as sensor networks, satellite-based geopositioning services, data processing as well as end-to-end responsibility for privacy and security requirements, depending on the specific requirements of the physical network services.



The evolution of heterogeneous operator platforms

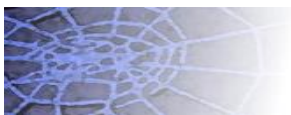
Disruption of conventional network industries driven by the IoT is concomitant with the emergence of innovative operator platforms. Among the open set of innovative case studies only three examples are chosen for illustrations:

- *Mobility as a service platforms*
can be organized for physical intermodal transportation services from different providers (e.g. bus and train). Complementary to the changing markets for physical transportation services heterogeneous virtual networks for shared mobility services evolve based on a combination of mobile real-time communication, global geopositioning services and sensor-based data processing.
- *Networked driverless vehicle platforms*
provide highly interactive (cooperative) networked/automated vehicles with the support of high-volume location critical big data processing (edge cloud), where the function of driver responsibility is shifted to the platform operator for the transportation process.
- *Microgrid platforms*
challenge the conventional value chain in electricity networks due to bottom up renewable energy production and consumption within home networks. Complementary to the physical microgrid platforms are virtual networks providing the ICT logistics of microgrids.



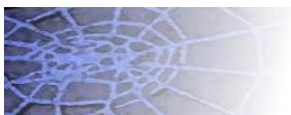
The governance of heterogeneous operator platforms

- Disruption of conventional network industries and the emergence of innovative physical operator platforms provide challenging governance problems of contractual relationships among different actors involved.
- The question regarding the proper governance arises focusing on the role of spot market transactions versus long run contractual relationships as well as idiosyncratic relationships (vertical integration). The problem solution competence of operator platforms is the entrepreneurial search for the required governance structures.
- Operator platform need as input a combination of physical networks and network services with complementary (big data) virtual networks. The problem of division of labor between all-IP broadband network providers, virtual network service providers, and platform operators arises concomitant with the implementation of adequate governance structures.



Enterpreneurial search for adequate governance structures (1)

- *Governance between All-IP network providers and virtual network providers:*
Contractual relations between (application-blind) multipurpose All-IP networks and (application-aware) virtual networks for operator platforms can be based on market transactions and competitive market prices.
- *Governance between platform operators and virtual network providers:*
Whereas the applications of mobility Apps in shared mobility markets can be implemented via short term spot markets, real time adaptive organization of import/export of electricity within microgrids may best be carried out via long-term contracts. Incentive for vertical integration between (physical) platform operators and virtual network providers may arise within networked driverless vehicle platforms due to strong idiosyncratic kind of unverifiable knowledge problems between physical and virtual services.



Entrepreneurial search for adequate governance structures (2)

- *Governance between platform operators and physical infrastructure providers:*

Contractual relations between platform operators and physical infrastructure providers are driven by the requirements of intermodal market transactions of network access with choice of intermodal combination of shared mobility services etc.

Access of platform operators to physical infrastructure capacities (e.g. airport slots, track capacities) may be organized by spot markets or long-term contracts. Since the interoperability between network service provision and infrastructure can be guaranteed by adequate standards the necessities for vertical integration to internalize idiosyncratic knowledge problems do not hold.



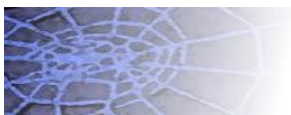
Entrepreneurial search for adequate governance structures (3)

- *Governance between platform operator and participants of the platform:*

Contractual relations between platform operator and participants of the platform (producers, prosumers, consumers) may vary depending on the design and requirements of heterogeneous operator platforms.

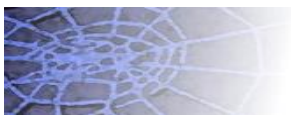
Ride sourcing platforms may only provide the organizational platform such that individual car rides are matched with the need of passengers without owning the vehicles. Alternatively, a shared mobility platform can also own a fleet of vehicles (e.g. minibuses) which they own and operate in a centrally dispatched transportation mode.

The interaction between users of operator platforms and platform operator may require related admission procedures, obligations to provide sensor-based metering data for billing procedure, share user data for aggregator/operator activities as well as liability rules for insurance purposes of platform operators. Platform user conditions may also vary in their specifications of obligations regarding metering information and sensor equipment within home networks, black box equipment for car security or IoT application equipment, insurance, health conditions etc.



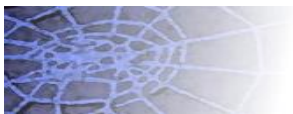
Is there a need for market power regulation of operator platforms? (1)

- A key question is whether the interaction between platform operators and the providers of the underlying physical infrastructure raises market power problems, which then would require regulatory interventions. Although direct and indirect network externalities as well as the potentials of economies of scale are significant for operator platforms, they are in their very nature network service markets with potentials for active and potential competition.
- In contrast, physical infrastructures may have the characteristics of a monopolistic bottleneck (natural monopoly in combination with irreversible costs) and thereby possess network specific market power. Sector specific price-level regulation of access tariffs and accounting separation is required to guarantee non-discriminatory access to monopolistic bottlenecks . Only if platform operators as well as conventional physical network service providers gain access to complementary physical infrastructures at non-discriminatory access charges undisturbed competition on the markets for network services can evolve.



Is there a need for market power regulation of operator platforms? (2)

- As it turns out intramodal regulation of monopolistic bottleneck infrastructures is a precondition for undisturbed intermodal platform competition which should be enabled by access regulation to monopolistic bottleneck infrastructures. For the case a platform operator would also own an (upstream) monopolistic bottleneck infrastructure disaggregated market power regulation should also be applied.
- The shift from conventional network services providers to operator platform providers is a gradual evolutionary process. Competition between conventional network service providers and platform operators requires a discriminatory free treatment of all providers. Of particular importance is the discriminatory free access to (upstream) physical infrastructures. Conventional network service providers such as providers for rail services and bus services or regional electricity utilities may gain an increasing role within future ICT based intelligent networks with a more flexible, real time and location based adaptive allocation of service capacities.



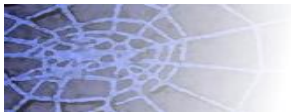
Is there a need for market power regulation of operator platforms ? (3)

- ICT based smart networks are characterized by large innovational potentials for changing the architectures of physical networks as well as changing markets for network services. Thus, market driven operator platforms for IoT applications are facing highly innovative markets with entrepreneurial opportunities to develop new innovative services and thereby disrupt conventional network industries.
- It is to be expected that operator platforms will not require a new paradigm of market power regulation. Although direct and indirect network externalities as well as the potentials of economies of scale are significant for operator platforms, they do not result in network specific market power. If the owner of a network infrastructure has network specific market power, he should be obliged to guarantee non-discriminatory access to platform operators at regulated access charges.



Appendix: references (1)

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